Rec'd PCT/PTO 25 FEB 2005

10/525921

VIDEO-STORAGE NETWORK HAVING INCREASED PERFORMANCE

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. 119(e) to U.S. Provisional Patent Application Serial No. 60/406,623, filed August 28, 2002, and incorporated by reference herein.

TECHNICAL FIELD

This invention relates to a video storage network for storing video information.

BACKGROUND ART

In the past, video editing occurred on stand-along devices, typically videotape machines. An editor seeking to create a video segment comprised of separate clips would queue the clips in the desired order on one or more source machines and then select desired clip for recording. The advent of shared video storage greatly changed the manner in which video editing now occurs. With present day shared storage networks, multiple users can each edit a copy of the same content using non-linear editing techniques. Many present-day video storage networks often place limits on the number of users because of bandwidth constraints. The switch fabric of such video storage networks often will not allow more than a limited number of users to access the storage facility. Overcoming this drawback by providing additional links increases overall cost.

Thus, there is need for a technique for providing a shared video storage system that overcomes the aforementioned disadvantage.

BRIEF SUMMARY

Briefly, in accordance with a preferred embodiment, there is provided a storage system for storing content, and preferably, video files. The storage system of the present principles includes a storage mechanism, a large disk drive, or one or more Redundant Arrays of Inexpensive Disk Drives (RAIDs). The storage system further includes at least one local cache storage unit for mirroring at least a portion of the content stored on the storage mechanism. Thus, a user can obtain such mirrored content from the local cache storage unit rather than the

storage mechanism, thus reducing the bandwidth demands on the storage mechanism. A write director is coupled to the storage mechanism and the one local cache storage unit for controlling the incoming content written into the storage mechanism and the local cache storage unit. A cache manager manages the content coherency between the storage mechanism and the local cache storage unit so that at least some of the content on the storage mechanism also exists on the local cache storage unit and vice versa. A read director responds to a content request from a user and directs the request to one of the storage mechanism and the local cache storage unit depending on the content availability of each. In this way, if the content is available on the local cache storage unit, the user reads from that unit rather than the storage mechanism. A storage mechanism access manager monitors the reading of content from, and the writing of content to the storage mechanism to control the read and write managers accordingly.

BRIEF SUMMARY OF THE DRAWING

FIGURE 1 depicts a block schematic diagram of a storage system in accordance with a preferred embodiment of the present principles.

DETAILED DESCRIPTION

FIGURE depicts a storage system 10 in accordance with a preferred embodiment of the present principles that affords improved efficiency. At is heart, the storage system 10 includes a storage mechanism 12 comprised of a single disk drive, or one or more Redundant Arrays of Inexpensive Disk Drives (RAIDs) that receive content for subsequent access by a user. Typically, the storage mechanism 12 stores video files with or without embedded audio for editing and/or broadcast. Having all users access the storage mechanism 12 at any given time will constrain bandwidth, thus imposing limitations on the maximum number of users. To overcome this disadvantage, the storage system 10 of the present principles also includes at least one local cache storage unit 14, and preferably, a plurality of such units. Each local cache storage unit 14 typically takes the form of a disk drive or one or more RAIDs.

As discussed in greater detail below, the local cache storage unit 14 mirrors at least some of the content stored on the storage mechanism 12. In other words, the local cache storage unit 14 stores at least some of the same files as the storage mechanism 12. In this way, a user seeking to access a particular file stored both on the storage mechanism 12 and on the local cache storage

unit 14 can access the local cache storage unit rather than the storage mechanism. Accessing the local cache storage unit 14 reduces bandwidth demand on the storage mechanism 12. In practice, different groups of users each can have a dedicated local cache storage unit. Alternatively, assignment of a local cache storage unit 14 to a group of users can occur on a dynamic basis.

A write director 16 controls the writing of input content from an external source (not shown) to each of storage mechanism 12 and the local cache. Such input content can include live video received from a camera or a satellite feed, or previously recorded video. In practice, the write director 16 takes the form of a programmed processor, hard-wired logic circuit, or field programmable array (FPGA) or the like that responds to control information received from a storage mechanism access manager 17 that monitors the read and write load on the storage mechanism 12. In practice, the storage mechanism Access Manager 17 takes the form of a programmed processor, hard-wired logic circuit, or field programmable array (FPGA). In accordance with the output signal from the storage mechanism Access Manager 17, the write director 16 directs incoming content to either or both of the storage mechanism 12 and the local cache storage unit 14.

A cache manager 18, typically in the form of a programmed processor, hard-wired logic circuit, or field programmable array (FPGA) or the like, controls the writing of content between the local cache storage unit 14 and the storage mechanism 12 in accordance with control signals from the local cache storage unit to maintain content coherency. In other words, the cache manager 18 maintains at least some content in common on the storage mechanism 12 and the local cache storage unit 14. To accomplish this task, the cache manager 18 undertakes background copying of files to the local cache storage unit 14 from the storage mechanism 12 ("trickle down"). Likewise, the cache manager 18 undertakes background copying of files to the storage mechanism 12 from the local cache storage unit 14 ("trickle up"). Such trickle up becomes necessary when a user edits content for subsequent use by others. The rate at which "trickling down" and "trickling up" occurs is a function of the overall bandwidth demand on the storage mechanism 12. The cache manager 18 also manages the storage capacity of the local cache storage unit 14 by deleting infrequently accessed files. Should the available storage capacity of the local cache storage unit 14 exceed a prescribed level, the cache manager 18 will delete the least recently accessed file first. Thereafter, the cache manager 18 will delete the next least recently accessed file and so on until the available storage capacity of the local cache storage unit 14 reaches an acceptable level.

To read content from the storage system 10, a user enters a read request received by a read director 20. In practice, the read director 20 takes the form of a programmed processor that monitors the content on both the storage mechanism 12 and the local cache storage unit 14. Upon receipt of a read request, the read director 20 determines whether the requested content resides on the local cache storage unit 14. If so, the read director 20 sends a command to a read source selector 22, typically a multiplexer, to designate the local cache storage unit 14 as the source of the requested content. Thus, under such circumstances, the read director 20 "redirects" the read request to the local cache storage unit 14. In the event the local cache storage unit 14 lacks the requested content, the read director 20 causes the source selector 22 to select the storage mechanism 12. Alternatively, the read director 20 will cause read source selector 22 to select a storage unit 24 provide the user with filler content in the event the local cache storage unit 14 can not provide the requested content and insufficient bandwidth exists to permit access to the storage mechanism 12. When the local cache storage unit 14 lacks the requested content, the read director 20 alerts the cache manager 18. In response, the cache manager 18 initiates a trickle down copy operation to transfer the content from the storage mechanism 12 to the local cache storage unit 14.

In operation, the storage system 10 advantageously offers improved performance by reducing bandwidth demands on the storage mechanism 12. The local cache storage unit 14 serves to mirror at least some of the content on the storage mechanism 12, thus providing an alternate source for supplying such content to a user. The cache manager 18 carefully manages the local cache storage unit 14 in response to the state of the storage mechanism 12, as monitored by the storage mechanism access manager 17, to assure that local cache storage unit will contain the requisite content. The storage mechanism access manager controls the reading of content from, and the writing of content to the storage mechanism during intervals of high bandwidth demand.

The foregoing describes a storage network having improved performance.